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ACTINOMYCOSIS, OR LUMPY JAW.

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This disease, which was formerly known by veterinarians as *osteosarcoma*, is an infectious disease of cattle which may also attack other animals and man. It is caused by a fungus called the *Actinomyces bovis*, which generally leads to the development of tumors about the head or neck, and which may in addition attack the lungs or other internal organs. The disease was known as wooden tongue when it affected this organ, because it increased the size and made the flesh very hard, like a piece of wood. The changes produced in the lungs were not looked upon as of the same nature as the tumors of the head until after the discovery of the *actinomyces* fungus. In this situation it was probably often thought to be tuberculosis. The fungus was probably first seen in 1860 by Perroncito and Rivolta. It was also observed in 1870 by Hahn. Bollinger was the first to carefully study the germ and give an exact description of it, and to demonstrate its effects in the production of the disease. This he did in 1877.

The fungus was studied botanically by Harz, who gave it the name of *actinomyces*, or ray fungus. Since then the disease has received much attention and investigation, and has been studied with special care by Israel, Ponfick, Bostrom, and Wolff.

Causation.—The tumors and abscesses of this disease, wherever they are situated, are found by microscopic investigation to originate from the presence of the *actinomyces*. On opening these different lesions, a careful examination with the naked eye or with a hand lens will often reveal minute granules, which vary from a very light yellow to a sulphur-yellow color. They may be abundant or they may be very scarce, and are found both in the soft tissue of the tumor and in the pus of the abscesses.

When these granules are separated and examined they appear as small globular masses about one-fiftieth of an inch in diameter. If they are crushed and examined under a microscope their outer portion is seen to be made up of club-shaped bodies, radiating from the center of the mass and making a body of the shape of a rosette. The interior of the rosette is found to be made up of very fine filaments, which probably connect with the club-shaped bodies. If the preparation is treated with a dilute solution of caustic soda or potash, this brings out the structure of the bodies more clearly. In some cases there is a deposit of mineral salts which obscures the structure of the granules, and in that case the examination is facilitated by treating them with weak acetic acid, which dissolves the lime salts and increases the transparency.

When these rosette-shaped bodies, or minute fungi, gain an entrance into the tissues and multiply there they set up an irritation which

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develops into inflammation, and leads to the formation of swellings and abscesses. After having begun to multiply in the tissues there appears to be no limit to their increase, and consequently the tumors continue to enlarge and the discharge of pus to increase until the strength of the animal is exhausted, and death results from this cause.

The exact nature of the parasite and its place in a systematic classification appears not to have been settled by botanical investigators. Some have considered it a true fungus, while others place it with the higher bacteria. This fungus grows in nature upon various plants, particularly upon the heads of barley and other grains, and probably also upon a variety of grasses. The beards and straw of the affected plants contain the parasite, and when these puncture the skin or the mucous membranes, the fungus is introduced, and the disease starts from this point of inoculation.

While the actinomyces may penetrate the tissues in various parts of the body, they generally enter through the mucous membrane of the mouth. When the animals eat the plants upon which the fungus is growing the mucous membrane may be punctured by sharp woody pieces, or these may gain lodgment at the side of a tooth. When once introduced into the tissues they continue to grow and invade the neighboring parts. A favorite place for the multiplication of the germ is the connective tissue beneath the skin of the jaw. In European countries it very frequently affects the tongue, but in the United States this form of disease appears to be rare. The fungus may also reach the lungs and multiply there, but the manner in which it gains access to these organs is not definitely known. It is found, however, that a considerable proportion of the animals which have the tumors on the jaw also have disease of the lungs, particularly if these discharge pus into the mouth. In rare cases the fungus appears to gain entrance to the interior of the blood vessels, when it is carried throughout the body with the blood, and the diseased process is found progressing in a considerable number of organs. In this case it is said to be generalized. The fungus is also said to penetrate the body through the orifices of the teats, and in this case it sets up an inflammation of the udder.

There has been considerable difference of opinion about the inoculability of actinomyces, and many investigators who have made experiments to transmit the disease from one animal to another have failed. It appears to be difficult or impossible to produce it in an active form by inoculation with the discharges from the swellings or abscesses. It may, however, be transmitted by inoculation if pieces of the diseased tissues are introduced beneath the skin or in the abdominal cavity of healthy animals. This fact would appear to indicate that the fungus is most virulent when it is growing upon some solid substratum, such as the tissues of animals or plants.

Symptoms.—The presence of actinomycosis is generally made apparent by a swelling in locations where it may be readily seen and examined. When the tongue is affected the animal finds it difficult to eat, the tongue is swollen painfully, and in the advanced cases hangs from the mouth with abundant salivation. When the pharynx is affected there is difficulty of swallowing, and when the larynx is involved there is a difficulty of breathing. Most frequently in this country the tumor is seen on the external surface of the jaw. It usually begins in the connective tissue beneath the skin, but soon extends to the bone, which it penetrates, causing this to become thickened and porous. The swell-

ing is at first hard, but later it softens and an abscess forms in the interior which generally opens on the external surface of the body, but may also form a channel into the mouth.

The newly formed tissue of the tumor increases in amount until it gradually forces its way through the opening, and projects from this in the shape of a mushroom, being constricted by the small aperture in the skin. The swelling may increase in size until it reaches 6 to 10 inches in diameter.

In some cases the disease begins in the interior of the bone, the fungus having entered through the alveolus of a tooth, but the process of development is the same as when it first lodges in the soft tissues. The tumors which have reached an advanced stage of development present a large raw surface of newly formed tissue which is covered with pus that escapes from numerous channels and constantly drops from the diseased mass. Such tumors may appear on either the lower or upper jaw, or on other parts of the head or neck. When the lungs are affected there may be no visible symptom, or there may be a cough and loss of flesh, as in other chronic lung diseases.

In England the disease appears to be most generally localized in the tongue; in Denmark the soft parts of the head are oftenest affected, while in some parts of Germany it is most frequently seen as a swelling of the pharynx. In this country, as is well known, it most frequently attacks the lower jaw.

Cruikshank mentions the case of a bull in England in which the skin of the flank became extensively diseased, and this process extended to the scrotum. The skin was covered with a leathery crust and its vitality destroyed. When pieces of this dead skin were pulled away pus was seen beneath it, penetrating into the connective tissue, and the yellow fungi could be easily made out. In certain cases the disease may be found in the stomach, intestines, the mesenteric and bronchial glands, and in the various bones, joints, and muscles.

The diagnosis of the large tumors on the head and neck is generally easy, as their location and appearance are in most cases sufficient for this purpose. In case of doubt, a microscopic examination of the discharge or of the tissue from the tumor must be made in order to determine if the fungus exists. When found in the lungs and other parts of the body the appearances resemble somewhat those seen in cases of tuberculosis, and the determination of the nature of the disease turns upon the presence or absence of the *actinomyces fungus*.

Prognosis.—The disease is usually chronic and of slow development, but it tends to advance until a fatal termination is reached. A very small proportion of the cases may recover spontaneously, the tumors being encysted or undergoing calcification. In most cases the disease yields readily to proper treatment, and about 75 per cent of the affected animals may be cured.

Treatment.—For a long time the only satisfactory treatment for actinomycosis was to remove the tumors by a surgical operation and treat the wound thus made with strong solutions of iodine. Many cases, particularly in the early stages, were cured in this way, but when the bones of the jaw, or the lungs or other internal organs were affected, they were beyond reach of this treatment.

About 1885 Thomassen, of Utrecht, recommended the use of iodide of potassium given internally as a cure for actinomycosis of the tongue. Between that time and 1883 he treated 80 cases, all of which were

cured. Nocard called attention to this treatment in March, 1892, having used it successfully on a number of cases of the tongue disease. Norgaard, of the Bureau of Animal Industry, appears to have been the first to succeed with this treatment in the disease as it affects the jaws. In April, 1892, he treated a steer with a tumor on the jaw measuring $15\frac{1}{2}$ inches in circumference, from which there was an abundant purulent discharge. This steer was entirely cured. The Bureau of Animal Industry afterwards purchased and treated 185 head of affected animals in all stages of the disease, and cured 131 of them, or about 71 per cent. In most of these cases, after treatment was finished, there was only a bunch of fibrous tissue to show where the tumor had been.

The iodide of potassium is given in doses of from $1\frac{1}{2}$ to $2\frac{1}{2}$ drams once a day, dissolved in water, and administered as a drench. The dose should vary somewhat with the size of the animal and with the effects that are produced. If the dose is sufficiently large there appear signs of iodism in the course of a week or ten days. The skin becomes scurfy, there is weeping from the eyes, catarrh of the nose, and loss of appetite. When these symptoms appear the medicine may be suspended for a few days and afterwards resumed in the same dose. The cure requires from three to six weeks' treatment. Some animals do not improve under the treatment with iodide of potassium, and these are generally the ones which show no signs of iodism.

If there is no sign of improvement after the animals have been treated four or five weeks, and the medicine has been given in as large doses as appear desirable, it is an indication that the particular animal is not susceptible to the curative effects of the drug, and the treatment may therefore be abandoned.

It is not, however, advisable to administer iodide of potassium to milch cows, as it will considerably reduce the milk secretion or stop it altogether. Furthermore, a great part of the drug is excreted through the milk, making it unfit for use. It should not be given to animals in advanced pregnancy, as there is danger of producing abortion.

Sanitary considerations.—The contagiousness of the disease under natural conditions is contested by the best authorities. It is plain, however, that the fungus is scattered over the pastures by the affected animals, particularly if there is a discharging tumor or abscess, and the infectious principle is perpetuated in this way. It is wise, therefore, to keep or dispose of affected animals as soon as the nature of the disease can be determined. In this way it appears that the fungus may be eradicated from the pastures, at least to a considerable extent, and the cause of infection removed.

It is not known that people can contract this disease from eating infected meat. Cases of it have been observed in man, but the individuals appear to have become infected in the same way that cattle do, by chewing grain or straw in which the fungus was growing. When the tumors in the carcass are small, not larger than the size of a walnut, and not generalized, the affected parts should be destroyed and the remainder may be used for human food. When, however, the disease is sufficiently developed to cause large swellings and abscesses which are freely discharging pus, and when the general health of the animal is affected, the carcass should be condemned, as the meat is not in a proper condition for food. The carcass should also be destroyed when the lungs or internal lymphatic glands are affected, or when there are a large number of centers of disease scattered throughout the body.